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ABSTRACT

The movement toward math and science curriculum standards is inextricably linked with high-stakes politics. There are two major types of politics discussed in this paper: the allocation of curriculum content, and the political issues involved in systemic change. Political strategies for gaining assent to national, state, and local content standards are analyzed. Major interest groups and coalitions are included. (Author)

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Research Monograph No. 2

The Politics of Developing and Maintaining Mathematics and Science Curriculum Content Standards

Michael W. Kirst and Robin L. Bird

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The Politics of Developing and Maintaining Mathematics and Science Curriculum Content Standards

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Abstract

The movement toward math and science curriculum standards is inextricably linked with high-stakes politics. There are two major types of politics discussed in this paper—the allocation of curriculum content, and the political issues involved in systemic change.

Political strategies for gaining assent to national, state, and local content standards are analyzed. Major interest groups and coalitions are included.

Introduction

As the national standards debate demonstrates, curriculum policymaking is essentially a political as well as a technical process (Ravitch, 1995). Politics is the authoritative allocation of competing values. Curriculum disputes over such topics as AIDS education and creation science highlight the embedded values conflicts (Wirt & Kirst, 1992). Proposals to increase curricular scope have reached their current conclusion when elementary teachers are expected to teach reading, writing, several varieties of arithmetic, geography, spelling, science, economics, music, art, foreign languages, and history at the same time as they help children to develop physically, morally, and intellectually and mold them into good citizens.

The oldest and simplest solution to deciding curriculum standards is to endow an individual or small group with the authority to make these decisions by exercising professional, and presumably expert, judgment (Massell & Kirst, 1994). This decision-making body (e.g., a state school board or a national subject matter association) is linked to the community that gives it authority and power. This linkage provides the decision makers with a degree of autonomy that ranges from absolute responsiveness to virtual independence. For example, the Clinton administration's 1994 Goals 2000 law advocates that disputes concerning national standards content should be resolved by a part of the federal government.

But this proposal only pushes our search one step further. What sort of decision procedures do curricular decision makers follow? In the past, the procedure could best be described by what Lindblom and Braybrooke (1963) called a strategy of *disjointed incrementalism*, that is, a strategy that simplifies complex problems. The major features of disjointed incrementalism are (1) acceptance of the broad outlines of the existing situation with only marginal changes contemplated, (2) consideration of only a restricted variety of policy alternatives, excluding those entailing radical change, (3) consideration of only a restricted number of consequences for any given policy, (4) adjustment of objectives to politics as well as vice versa, (5) willingness to reformulate the problem as data become available, and (6) serial analysis and piecemeal alteration rather than a single comprehensive overhaul.

In short, many curricular decision makers use pragmatic methods of decision making that result in minimal changes at the margin. Conflict can be avoided by using vague language concerning standards and covering so many topics that no major interest group feels left out. Content priority is sacrificed to the political necessity of coverage.

The push for national mathematics and science standards, however, proposes to change this disjointed incrementalism to a nonincremental reconceptualization and complete overhaul of subject matter standards and exams. Examples cited by national standards advocates include recent efforts by the National Council of Teachers of Mathematics (NCTM) and the National Academy of Sciences (Massell & Kirst, 1994). The politics of these efforts are complex, as one observer of the NCTM noted:

> Twin needs propelled the development of NCTM's standards for school mathematics: the need to gain consensus and the need to promote change. On the one hand, if these standards were to stand as the banners of the community, then

> they had to reflect shared values and commitment. On the other hand, if change was desired, then these standards had to do more than reflect current practice. New ideas were needed, ideas that departed from extant assumptions and practices. (Ball, 1992, pp. 2-3)

In short, national, state, or local content standards require complex trade-offs, and there is no way to avoid conflict and a sense of winners and losers. Difficult choices must be made concerning content standards and the procedures by which these standards are set. Merely following the "right" procedural steps will not be sufficient. For instance, one constraint is school time, because not everything that all content advocates want can be taught in 180 days from 8:00 a.m. to 2:30 p.m. The history of curriculum politics has been one of jockeying for priority in an overcrowded school schedule. Some curricular priorities are politically organized into the curriculum while others are neglected. Historically, organized interests such as driver education and vocational education have been more effective politically than music education (Wirt & Kirst, 1975).

Efforts to formulate curriculum standards have provoked conflict over the proper bases for deciding what to teach. Authoritative allocation of resources in these value conflicts is the essence of what we mean by the political process in curricular decision making. Should schools teach those things that are likely to be immediately useful in life outside the school, or those things most fundamental to an understanding of organized knowledge? Should they emphasize the development of individuality, or the transmission of common cultural heritage? So long as people disagree on how to evaluate curriculum, they are bound to quarrel over its composition. The bases for this disagreement can be such things as social class or race.

From 1900 to 1970, four broad bases for evaluating curricular elements emerged as salient—tradition, science, community, and individual judgment. These values cohere people's preferences, but their conflicting nature creates political stress and demands for curricular changes. They are neither mutually exclusive nor exhaustive, but do represent major streams of thought and feeling among curricular constituencies. In short, they are ways of answering Herbert Spencer's question, "What knowledge is of most worth?"

The *appeal to tradition*, exemplified in recent times by the Great Books program and the Council for Basic Education, rests on the assumption that subjects of study that survive the test of time are in the long view most beneficial and, therefore, should receive the highest priority in the curriculum. The *appeal to science*, the newest basis for curricular decision making, has received strong support from many influential groups, including the U.S. Department of Education. This appeal rests on the assumption that educational and psychological research will reveal cognitive concepts that should guide teaching.

The *appeal to community* presupposes that every school is part of a community of association and interests, in which reside the ultimate criteria of usefulness, relevance, and benefit of any curricular element. Therefore, those matters that deserve first priority in the curriculum are to be determined by the community, either directly, via its representatives, or by studies of the community. The *appeal to individual judgment* amounts to a skeptical

denial of any rational value basis for curriculum making beyond the student's own values, needs, and desires as these are manifested in his own considered judgments. Adherents of this position argue that any basis for curriculum is doomed to failure if it purports to provide answers to Spencer's question.

Each of these values has its supporters and detractors, who bolster their positions with techniques that we regard as political. Some schools stand primarily, and reasonably consistently, on only one of these bases. The curriculum of St. Johns University is based largely on the appeal to tradition, as are the curricula of a number of private "Latin" schools. A number of Christian groups advocate a traditional curriculum. By contrast, several schools embrace a scientific basis such as constructivist pedagogy or stimulus and response psychological rewards. "Free" schools and "free" universities base their programs on free choices of individual students. Afrocentric schools are oriented to a community focus. But by and large, U.S. public school programs are a heterogeneous mixture of these different bases. As such, they reflect the political compromises and diverse values found in any state or local district.

Recent History of Politics of Science and Mathematics Reform

The political disputes of recent years were foreshadowed by post-World War II developments. Until the 1950s mathematics and science curricula were selected by individual school systems in response to perceived desires of local communities. The successful launch of Sputnik I in 1957 created demands for stronger federal and state roles using two broad strategies—more mathematics and science at all levels and different content and instructional foci (Yee & Kirst, 1994).

Nevertheless, there were strong demands for preserving local control on some traditional curriculum matters, and political conflict surrounding curriculum escalated in the 1970s (Dow, 1991). Efforts to ban books doubled in the first five years of the 1970s over the last five of the 1960s. A 1974 book-banning crusade exploded into life, threatening violence in Kanawha County, West Virginia. The American Library Association reported three to five episodes a week in 1981 ranging from the Idaho Falls banning of *One Flew Over the Cuckoo's Nest* to Anaheim, California, excising Richard Wright's *Black Boy*. After the Warsaw, Indiana, school board banned forty copies of *Values Clarifications*, the school board president posed the essential political question, "Who shall control the minds of the students?" (Wirt & Kirst, 1992).

One federal attempt to take a role in influencing local curriculum was rebuffed in the 1970s. Congress cut back the federal curriculum development role in large part because of a 1975 debate on the National Science Foundation's proposed social curriculum "Man: A Course of Study" (MACOS). Typical of this pressure was the charge of Congressman John Conlan (R-Arizona) that MACOS was a federal attempt to "use classrooms for conditioning, to mold a new generation of Americans toward a repudiation of traditional values, behavior, and patriotic beliefs" (Wirt & Kirst, 1992). Yet twenty years earlier the federal government had entered the curriculum and text development field because critics alleged that schoolbooks

were outdated, inaccurate, dull, and lacking in diversity. Scholars and experts, whom federal and state governments rely on, have been criticized for trying to impose their own cosmopolitan and secular values upon diverse local communities. Curricular reform itself has been professionalized through government and foundation grants. No longer are perceived crises such as Sputnik required to generate curriculum change, because curricular change now has a self-starting capacity.

Curricular conflict has many roots. Military threats or changes in public sentiment such as the women's movement generate value conflict about curriculum, even though this is not why these events were initiated. Other forces, such as court decisions favoring bilingual education or the pronouncements of influential individuals, can change the curriculum orientation without the direct development of new materials. In order to incorporate all these influences, the process of new textbook creation is "managed," whereby a writing team prepares a series of texts. The actual author is frequently the publisher's internal editor, not the authors listed on the title page. Teachers are also contributors to textbook content through their instructional preferences.

These skeletal concepts can be brought to life by the flesh of reality provided in a specific education issue. The reform of the mathematics curriculum in this country from the mid-1950s to the late 1970s nicely illustrates these multiple influences. It also shows the essentially political nature of curriculum decision making, even though professionals often regard curriculum as apolitical and something to be shielded from gross political concerns.

The traditional methods of teaching mathematics in public schools are rooted in early nineteenth century pedagogy. But for some time mathematicians and school mathematics teachers had been discontented with these methods. During this private-issue stage of policymaking, discontent was not sufficient to generate anything other than a scattered questioning of the old ways. Some university professors were experimenting with a new approach to mathematics instruction, but there was as yet no sense of urgency or resource to act.

The private-issue transformation stage of policymaking occurred at the confluence of several dramatic events in the late 1960s.

Politics of the New Math—1960-1970

Americans were enormously shocked in the late 1950s by the Russian success in orbiting the first space vehicle, the Sputnik. Critics of the American schools were already charging educators with educating the modern generation poorly; they seized on Sputnik as an illustration of how this American "defeat" was attributable to "poor" schools. Thus external technological changes were used by reform groups who had been working for changes in mathematics for many years (Dow, 1991). The media appealed to university curriculum specialists for enlightenment; parents made demands for action on state and national policymakers; and, in short, the issue quickly became a public one and was placed on the political agenda.

The crisis atmosphere of this issue's emergence illustrates how quickly a new national agenda can be created. Congress legislated and the U.S. Office of Education implemented a new law to proved monies for improving the quality of mathematics and language training and increasing the supply of such teachers. This National Defense Education Act (NDEA) of 1958 provided funds for developing new curricula in mathematics, training employed teachers in the new mathematics, and incorporating these changes into schools of education. In short, this policy output stage elevated the goal of providing students with better mathematics training to national attention by redistributing federal money to teaching methods aimed at that goal.

The implementation stage was impressive in its thoroughness as federal agencies fastened on a particular strategy of raising students' mathematics comprehension. This strategy involved a new way of thinking about mathematics theoretically, which could be taught from the first grade onward by methods that students could easily grasp. There was an attempt to blend the traditional curriculum ladder (arithmetic, geometry, beginning and advanced algebra, trigonometry, and—in some schools—calculus) in many localities. Students were introduced sequentially to different levels and relevant applications of such concepts as set theory. Thus, to get across the concept of numbering, instead of using the traditional method of counting to the base of ten, students were taught to count from the base of seven or another number. The logic of numbering was sought, rather than the rote learning of a multiplication table.

Federal funds underwrote eight- to ten-week summer training institutes for many teachers. Special text materials were devised and disseminated; later, computer usages became available. States endorsed these innovations, providing additional funds to incorporate the new into the old mathematics curriculum. Administrative state agencies beefed up their curriculum divisions relevant to mathematics programs and assisted in the implementation of the changes. Local school boards were encouraged to participate by releasing their teachers for summer instruction and to graft the new onto the old. In time, if one's school system did not enjoy the new mathematics, one felt left out of a national tide of change. Recall that such retraining and materials were provided for every level of schooling, and public and parochial schools alike were enlisted in moving the reform into the system and onto the students. This was all done in a remarkably few years.

The program-outcome stage produced several results, but one of them was unintended and eventually counterproductive. One goal was to improve mathematics training, and millions of students had been exposed to the new mathematics concepts and understood them reasonably well. Another goal was to institutionalize the reform, and there were thousands of local education agencies (LEAs) that had adopted the new curricular concept. Yet another goal was to prepare students for the application of mathematics to life, and some feedback that was quite critical developed. Parents (who often did not themselves understand the new mathematics concepts despite efforts to give them a quick exposure) increasingly complained that their children could not use mathematics for everyday requirements such as multiplying or adding in preparing a bill or grocery list.

So widespread did this negative feedback become by the opening of the 1970s that state laws and regulations were altered. State text adoptions returned to the old mathematics, and state tests changed accordingly. Signs that teachers were also reverting to the old mathematics contributed to this reversal. There was little evidence that students were learning mathematical principles any better. Indeed, with the widespread decline in mathematics and English test scores across the nation in the mid-1970s, few curricula could claim much success, and the new mathematics had no strong constituency within school systems or lobby organizations other than federal leadership through the National Science Foundation (NSF). It was not easy to monitor whether teachers stressed the new mathematics, and the new mathematics did not stimulate any addition or structural identity within the school bureaucracy. By the mid-1970s, new national priorities for the disadvantaged and the political feedback cycle resulted in a shift away from the new mathematics with little permanent residue. Some teachers continued to partially implement their NSF summer institute in new mathematics skills, but hostile external forces gradually diminished such content (Dow, 1991).

The Complexities of Systemic Change

Political developments in the 1960-1970 era underline the need to change the entire education system, but this strategy entails considerable political obstacles. The systemic reform strategy departs from the traditional practice of leaving content determination solely to individual teachers and local schools (Fuhrman, 1993). Frequent elections and turnover of key leaders make it very difficult for standards changes to persist long enough for systemwide implementation. The difficulty of re-electing federal and state leaders tends to preserve local control.

Historically, the educational system has not been designed for teaching a high level curriculum. Federal and state policies have tended to reinforce the use of textbooks and low-level basic skills curricula, which in turn have become the de facto national curricula (Elmore & Fuhrman, 1994). For example, it is typical for schools and teachers to make their decisions about what will get taught by deferring to textbook publishers' tables of contents and to let standardized tests required by states and districts define the skills children should learn (Elmore & Fuhrman, 1994); students are required by the state to take statewide multiple-choice tests and basic-skills examinations that typically emphasize single correct answers and often do not adequately emphasize analysis, statistical inference, multistep mathematical problem solving, hands-on science, synthesis, expository writing, and complex reading (Kirst, 1994). Neither texts nor tests encourage the development of high-level skills (Archbald & Newman, 1988; Frederickson, 1984; Fuhrman, 1993; Tyson-Bernstein, 1988).

In addition, there are no high stakes for the students, because teachers typically do not use students' scores on state assessments to determine grades. State tests are not used for college entrance, and employers rarely ask to see a high school transcript (Kirst, 1994). With the lack of explicit consensus about outcomes, low-level skills that are familiar and relatively easy to teach become the de facto curriculum (Fuhrman, 1993; Smith & O'Day, 1991). Since

the school system has no clear goals or directions, it cannot develop any authentic means by which to judge its progress, and thus, individual schools are left to use teacher grades.

Historically, policymakers have avoided making central determinations of outcome expectations because of support for local control. For the most part, educators have not tried to change the status quo, and in fact, many have argued against "policy interference" of this type in the past (Fuhrman, 1993). Educators have tended to be highly skeptical about policymakers' ability to develop ambitious and challenging standards for student achievement that can actually be carried out in the classroom. Their skepticism is based on the fact that it is easiest for politicians to set standards at levels that the current capacity can readily achieve. However, when standards are set too high, schools complain because they feel unfairly held to impossibly high standards (Ravitch, 1995).

Since many educators do not believe that the government is able to make enlightened education policy using top-down reform, they have placed their hope for educational improvement on individual school (bottom-up) efforts (Cohen, 1983; Cuban, 1984; Elmore, 1990; Furhman, 1993; Purkey & Smith, 1983). As long as there is a school-based "us" versus "them" at the policy level, systemic change may never be successfully achieved.

A third strategy integrates both top-down and bottom-up reform strategies, with both "sides" working together to help change the system. Project 2061 of the American Association for the Advancement of Science (AAAS) is a good example of the complex politics of systemic reform, as will be elaborated below.

Project 2061: Science for All Americans - A Specific Example of Systemic Reform Politics

In *Science for All Americans,* AAAS (1990) wrote, "Sweeping changes in the entire system from kindergarten through 12th grade will have to be made if the United States is to become a nation of scientifically literate citizens" (cited in Massell & Goertz, 1993, p. 3). *SFAA*'s primary goal is to make every American student "science literate" by the time he or she graduates from high school (Kirst, Anhalt, & Marine, 1996). Project 2061 completed Phase I in 1989 by forming literacy goals for science, mathematics, and technology; these are the understandings and habits of mind that the project felt are essential for all citizens in a scientifically literate society (AAAS, 1990). *SFAA* recommends that, over American students' elementary and secondary school career, their science education should focus on the following ten themes, each of which includes several major subtopics:

- The Nature of Science
- The Nature of Mathematics
- The Nature of Technology
- The Physical Setting
- The Living Environment
- The Human Organism
- Human Society
- The Designed World
- The Mathematical World
- Historical Perspectives

By identifying these broad themes, Project 2061 differentiated itself from traditional science curricula.

> The amount of detail that students are required to know according to *SFAA* is considerably less than in traditional science, mathematics and technology courses. In order to provide a foundation for a lifetime of scientific understanding, ideas and thinking skills are emphasized in Project 2061 at the expense of specialized vocabulary and memorized procedures. (AAAS, 1990, p. 5)

In addition, although many of the topics recommended by *SFAA* are already taught in most schools, "*SFAA*'s recommendations differ from standard practice in their attempts to soften boundaries between traditional scientific and other academic disciplines, emphasizing connections instead" (AAAS, 1990, p. 6). First of all, *SFAA* suggests that, throughout students' academic careers, when they study the ten themes, their science education should revolve around six major organizing concepts—systems, models, constance, patterns of change, evolution, and scale; students should also understand how these concepts cut across disciplinary boundaries (p. 6). Second, *SFAA* (1990) aims to design a science framework that will lead students to develop three so-called "habits of mind" —curiosity, openness to new ideas, and skepticism (p. 6).

Based on prior curriculum reform attempts, some controversial areas of *SFAA* (1990) appear to be (Tyack & Cuban, 1996; Kirst, Anhalt, & Marine, 1997):

- interdisciplinary connections that include science, mathematics, technology, and social studies.
- less content coverage and more in-depth analytical learning.
- more science in elementary school.
- greater emphasis on real world application.
- more mathematics, science, and technology for non–college-bound students.
- increased use of heterogeneous groups and decreased use of tracking.

All of these components involve significant conflicts and resistance from organized groups. Mathematics groups do not want to be subsumed within the science curriculum, and vocational educators are trying to feature technology education as their own, not as a part of science. The pressures for content coverage rather than in-depth topics are inherent in demands by university admissions and AP exams. The elementary school day is so crowded that some content or activity must be eliminated if science time is increased. Many attempts to detrack schools have caused resistance from parents of higher achieving pupils (Kirst, Anhalt, & Marine, 1996).

"Project 2061 has been a reform effort that prizes flexibility and openness in its developmental process," and "as a result, it is a growing organism continuously reshaping itself in response to new information" (Massell & Goertz, 1993, p. 2). However, when curriculum is more flexible and open-ended, teachers need to become more active decision-makers in the curriculum process than they currently are (Massell & Goertz, 1993). But teaching for understanding requires teachers to teach in a way that they were seldom taught (Elmore, 1993) and frequently goes against the grain of school organization variables such as 45-minute periods (Massell & Goertz, 1993, p. 30).

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The Politics of Explicit Science and Mathematics Standards

Today, mathematics and science curriculum developers are bridging the gap between legislation and the classroom by specifying content and performance standards, while at the same time trying to give teachers and local school districts a meaningful "zone of local discretion" over how to achieve the goals of the legislation (Elmore & Fuhrman, 1994; O'Day & Smith; 1993; Smith & O'Day, 1991). There are four main areas of political tension that make it difficult to develop a supportive coalition inside and outside the schools for new mathematics and science curriculum standards (Massell, 1994b). They are as follows:

1. The Tension Between Leadership and Political Consensus;
2. The Tension Between Flexible and Specific Standards;
3. The Tension Between Up-To-Date Dynamic Standards and Reasonable Expectations for Change in the System; and
4. The Tension Between Professional Leadership and Public Understanding of What New Standards Will Entail.

1. The Tension Between Leadership and Political Consensus

Previous educational reform efforts, especially large-scale curriculum reforms, have often been criticized for ignoring the social, political, and technical realities of implementation in schools and classrooms (Dow, 1991; McLaughlin, 1991; Yee & Kirst, 1994). The "new mathematics" and new science projects that were sponsored by the National Science Foundation (NSF) from the 1950s to the 1970s are good examples of programs that were criticized because parents, teachers, community leaders, administrators, and others "had only limited, if any, involvement in the development of the new curriculum, were uninformed about the changes they were expected to make, and were ill-prepared to defend the reforms when challenges arose at the local levels" (Massell, 1994b, pp. 186-187). Because of the failed reform efforts of the past, educators today are well aware of the types of problems that will arise if notions of change are not widely shared at the community level (Carlson, 1992). Thus, most of the standards projects today try to gather diverse input by engaging in a broad review and feedback process by professional educators, community members, and others who have an interest in the standards. Gathering diverse input alone, however, will not achieve the development and implementation of leading-edge content standards, because leading-edge content standards are frequently at odds with reaching broad consensus. Many groups have tried to develop consensus around content standards for their field, and even NCTM, one of the most successful, has been recently subjected to intense disputes.

Nevertheless, NCTM has been fortunate enough to achieve a high degree of initial consensus around the content standards that it designed (Massell, 1994b). The following are some of the processes that NCTM used to enhance the impact of the standards:

1. A long period of preparation prior to convening the standards-writing committees to lay some of the intellectual groundwork for mathematics reform.
2. Broad involvement in the development process. In contrast to past large-scale curriculum reforms, NCTM engaged more educators as well as subject-matter specialists on its drafting committees.
3. A far-reaching review and feedback. The organization embarked on an extensive consensus-building process that involved thousands of practitioners, academics, and other professionals as well as members of the lay public in different stages of setting the agenda. NCTM received the endorsement of major professional associations prior to the release of its standards document.
4. An extensive consensus and capacity-building effort after the standards were drafted. (Massell, 1994a, 1994b)

One should not be misled to think that science organizations will be successful at achieving content standards for their specific disciplines just by following the same steps that NCTM followed to formulate their standards (Collins, 1995). While the aforementioned processes do seem to have been critical for NCTM to achieve consensus during content standard formulation, there were also other factors that played an important role in NCTM's success, many of which are unique to the discipline of mathematics (Massell, 1994b).

Massell (1994b) describes the uniqueness of mathematics that seemed to aide NCTM in the formulation of its standards in the following manner:

> Mathematics, unlike science . . . , is not fragmented into a large number of competitive subdisciplines; furthermore, the subareas that do exist (i.e., geometry, algebra, calculus) share a common conceptual base and language that facilitates discussions across them and makes goals like "depth over breadth" more easily achieved. In contrast to...science, mathematics does not tend to galvanize debate on pressing social issues or political concerns. The mathematics community has relatively few national organizations, and many have overlapping membership. These elements strengthen communication and provide a more solid foundation for consensus. (p. 188)

The less turbulent political atmosphere in regard to standards at the time when NCTM developed its standards in 1988, compared to 1995, also facilitated its success. In fact, NCTM had to use its own resources to produce the standards because "federal and foundation actors did not think a national curriculum document was a good idea" (Massell, 1994b, p.188). Since NCTM had no external support, it had to construct support for the standards project from within its membership. The NCTM was also able to take its time (seven to nine years, depending upon how you count) to develop its standards, a luxury today's standards developers do not have.

Although NCTM, by having many factors in its favor and by following the processes it did, was able to achieve a degree of consensus around the content standards it designed, one cannot ignore the fact that there were professional disputes that arose during the formulation process that still linger today. For example, NCTM members have paradigmatic arguments

about how basic skills content should be taught, along with disagreements over when problem solving should be introduced (Massell, 1994a).

Members who took a behavioral approach argued for a teacher-centered direct instructional method stressing memorization. Behaviorists also argued that

> you have to crawl/walk before you can run. If formulas aren't memorized, there will be no basis for the mathematical reasoning. If there is no mechanistic answer finding, there will be no conjecturing, inventing, and problem solving. If you don't know a body of so-called isolated concepts and procedures, there won't be any connecting mathematics and its applications. Judicious use of old-fashioned rote memory and drill are as necessary today as they were in generations past. (Carlson, 1995, p. 9)

Other NCTM members thought that classrooms should be student-centered with emphasis upon mathematical reasoning learned through constructing and solving problems. Their timing argument, and the one that NCTM accepts, is that skills and concepts can and do emerge during the process of problem solving and should proceed in tandem (Massell, 1994a). The *Curriculum and Evaluation Standards* states:

> Two general principles have guided our descriptions [of students activities related to mathematics]: First, activities should grow out of problem situations; and second, learning occurs through active as well as passive involvement with mathematics. Traditional teaching emphases on practice in manipulating expressions and practicing algorithms as a precursor to solving problems ignore the fact that knowledge often emerges from the problems. This suggests that instead of the expectation that skill in computation should precede word problems, experience with problems helps develop the ability to compute. (NCTM, 1989, p. 9)

Even if current science standards developers follow the processes that NCTM used and are aware of paradigmatic conflicts that may arise within their discipline, diverse fields like science did not try to develop standards in the same way as NCTM did (Collins, 1995). Current science standards developers were not afforded the time they need to build discussion and agreement among their diverse members. When NCTM developed their standards, there were no political or time pressures under which they had to work. Science standards projects, like most other standards projects today, however, do not have the luxury of taking seven to nine years to achieve initial consensus, but rather were forced to adhere to strict and short time-lines. NCTM standards are under widespread political attack for their alleged emphasis upon using calculators and not providing enough training in logic and accuracy. Moreover, parents, employers, colleges, and vocational educators all have conflicting views about mathematics content priorities.

Realizing the unlikelihood of quick consensus among their diverse members, and the fact that the high-stakes market place of public ideas, professional status, and dollars may make dialogue and consensus a more difficult, some of the current initiatives

> have set out to develop national standards in their field without widespread agreement among their members. The actions of these standards initiatives can provide the various fields with a wonderful opportunity for broad-based discussions that may help to clarify the goals and purposes of the fields being discussed. With this in mind, future mathematics and science standards developers may find it necessary to approve standards that not everyone will support in order to achieve the goal of producing leadership in the field; they may even find that they must compromise certain aspects of the standards they want in order to survive political challenges. (Massell, 1994b, p. 189)

2. The Tension Between Flexible and Specific Standards

Historically, the United States has moved from local control of curriculum to state and federal governments increasing their roles. Thus, in order for national standards in mathematics and science to be accepted, the people of this nation must want to have them, and the standards must be flexible enough to allow for local elaboration and variation. Keeping this in mind, Smith and O'Day (1991) propose simultaneously to

> increase coherence in the system through centralized coordination and increase professional discretion at the school site. Thus while schools have the ultimate responsibility to educate thoughtful, competent, and responsible citizens, the state—representing the public—has the responsibility to define what "thoughtful, competent, and responsible citizens" will mean in the coming decade and century. (p. 254)

Today, the term *standard* is typically used as a sort of a flag that reflects the valued goals around which educators can rally and decide for themselves how the goals of the standards will be accomplished in their schools and classrooms (Ravitch, 1995). Thus, the new standards developers for mathematics and science may find it undesirable to enforce a particular set of practices or materials. Rather, mathematics and science standards could be designed to direct and guide local choice instead of determining and prescribing practice and teaching. No rigid or specific implications for practice would be inferred from standards (Ball, 1992; Myers, 1994; Sykes & Plastrik, 1992).

By being this flexible, mathematics and science standards developers may run into the problem of not knowing when their standards have become so flexible that they can no longer provide leadership (Massell, 1994b). The same concern over flexibility emerged among experts who were trying to design teacher knowledge assessments for the National Board for Professional Teaching Standards:

> By not creating standards at what we would call a fine-grained level . . . standard writers leave the critical work of operationalizing standards for exercises and judging to the assessment developers. We, not the standards committee . . . imagined the vignettes or examples of accomplished teaching, we attempted to ground the standards in research, and we think the standards committee should have been

involved in the assessment effort to operationalize standards. (Pence & Petrosky, 1992, p. 12)

Therefore, "a certain level of detail in the content standard is necessary to guide the construction of performance standards, which will then guide test specifications, and finally the development of the tests themselves" (Massell, 1994b, p. 192). If the mathematics and science content standards do not provide sufficient detail, then they will not pave the way for "other policy components such as assessment and instructional materials"; this is the same problem mathematics and science frameworks are struggling with today (Massell, 1994b, p. 192). Thus, the national debate on mathematics and science standards "must go beyond generally worded standards to include the development of curricula specific enough to guide teaching and assessment. These must be the first steps; a syllabus-based examination system will have to wait until standards are established, because we cannot insure that students have a fair chance to learn what is tested until we have a curriculum in place" (Koretz, Madaus, Haertel, & Beaton, 1992, p. 12). But with more specificity comes less flexibility for people at various levels in the system and more political objections to policymakers, who do not work in classrooms, telling teachers what to teach. Developing numerous, relatively detailed and precise strands of content keyed to a common set of standards is a possible resolution to the flexibility/specificity dilemma.

3. The Tension Between Up-To-Date, Dynamic Standards and Reasonable Expectations for Change in the System

In its 1992 report, "the National Committee on Educational Standards and Testing called for dynamic content standards, that is, standards that are continuously updated to reflect advances in scholarship" (Massell, 1994b, p. 193). But how often should standards be revised? We already know how difficult it is to develop standards, and with all the interlocking systemic components like teacher repertoires, instructional materials, and assessments that take time and significant resources to develop, frequent revisions are not practical. California currently revises its curriculum frameworks in a subject area on a staggered, eight-year schedule. That is, one particular content area framework is reviewed every eight years, with a new subject being addressed each year by the state policymakers. Eight years may seem like a long time, but if you break the process up into the time it takes to complete each step, one can see that eight years can become a very short time. For example, it takes approximately two years to revise the curriculum framework, and then publishers must be given enough time to align their texts accordingly. Furthermore, staff development, assessment, and other facets of the system must be constructed and implemented in the schools.

California has been frequently criticized for having its frameworks and assessments ready before the staff development and curriculum materials were in place (Massell, 1994b). Although the staggered schedule does not present a great burden of change on junior high/middle school and high school teachers, it does for the elementary teachers because they are responsible for the whole range of subjects and, therefore, have to reassess a key component of their curriculum every year (Massell, 1994b); the district curriculum supervisors have the same problem (Marsh & Odden, 1991). Thus, mathematics and science

standards developers must keep in mind a practicality and feasibility time-line; revised standards do nothing to help educate our students if our educational resources and systems cannot keep up with them.

Many educational frameworks, standards, and materials for mathematics, science, and other disciplines are also criticized because they tend to cover the "waterfront" instead of focusing only on a few key points or topics in great detail; that is, they cover a wide range of material superficially instead of emphasizing in-depth learning of key concepts. Typically, such broad and vague frameworks do not push publishers to develop high quality material, have little impact in the classroom, and are "seen as little more than 'good doorstops' " (Massell, 1994a, p. 119) when they are provided to districts, schools, and teachers, because of the intentionally vague language.

The politics that emerge between and among discipline members is a large factor that leads developers to focus on breadth rather than depth. For example, when frameworks and standards are being developed for a field like science that has various subareas (e.g., biology, chemistry, physics), it is hard to get developers to reach a consensus concerning what should be covered in depth (Collins, 1995). Instead of working together and compromising so as to develop in-depth coverage of a few key topics, developers tend to include everything. By using broad and vague terms, the developers do not offend the subareas (like physics or biology), because topics from one area do not get emphasized more than another.

4. The Tension Between Professional Leadership and Public Understanding of What New Standards Will Entail

Parents, religious groups, and other factions in society will continue to have an effect on the wording and contents of standards documents as well as what teachers choose to teach in their classrooms. Challenges to public school programs and materials are nothing new in America. As McCarthy (1995) noted:

> For decades civil rights groups have been challenging materials as racist or sexist or as curtailing free speech; consumer groups have been contesting materials that promote bad health habits; environmentalists have been critical of texts that do not encourage global responsibility; and parents and religious groups have objected to the language and orientation of particular books, courses, and activities. (p. 55)

Recent disputes, however, are different from the above mentioned challenges in many ways. In the 1960s and 1970s, "the most vociferous critics of public education usually came from the politically left" (Whitty, 1984, p. 52). Since the 1980s, however, more and more critics of public education have come from conservative citizen groups; the groups have been labeled as the "new right." Also, the number of challenges has increased dramatically, and the central focus of the challenges has broadened from single books to entire programs and strategies to redesign schooling (McCarthy, 1995). In addition the disputes have galvanized considerable media coverage.

> Battle lines are clearly drawn, misinformation abounds, vicious accusations are being hurled, logic is often replaced by emotion, and there seems to be little desire to compromise. (McCarthy, 1995, p. 55)

The conflicts today seem to reflect the different values and world views of educators, parents, business leaders and policymakers in regard to not only the purpose of schooling, but also the relationship between individual and societal interests in a democratic society (McCarthy, 1995; Marzano, 1993-94).

Traditional Curriculum Groups

Content standards based on *outcomes* of what students know and can do are confronting strong counterpressures. Outcome-based education (OBE) in California, Pennsylvania, Iowa, Ohio, Virginia, and Oklahoma was amended or eliminated from statewide mathematics and science content standards (Brockett, 1993). One of the nation's most outspoken outcome-based education critics is Peg Luksik, who ran a close race in the last Pennsylvania Republican gubernatorial primary. Luksik calls OBE a "sham" and says the basic philosophy that all students can learn "is just rhetoric that will guarantee a standard of lowest academic achievement" (Brockett, 1993). Ben Bancroft of Oklahoma Families Restoring Excellence in Education charges that "learner outcomes test values instead of academics, and emphasize self-esteem and problem solving, at the expense of knowledge in specific subjects" (Brockett, 1993, p. 8). The objection to problem solving is a significant problem for mathematics and science content standards formulated under contracts made in 1992 by the U.S. Department of Education. All of these contractors stress problem solving.

Organizations that favor a limited federal or state government role in school curriculum, such as the Eagle Forum (Phyllis Schafly) and conservative Christian churches (Pat Robertson), are being opposed by statewide big business groups such as the Business Roundtable. Business groups are concerned that local standards will not provide a well-prepared workforce. But the right-of-center movement is growing in strength and forming an impressive national political network.

Some of the most active groups are the American Coalition for Traditional Values, the American Family Association, the Christian Coalition, Concerned Women for America, Eagle Forum, Educational Research Analysts, Family Research Council, Focus on the Family, and the National Association of Christian Educators/Citizens for Excellence in Education (NACE/CEE). Most of these groups are considered part of a loose coalition that emerged in the early 1980s.

CEE has a simple agenda:

- To return academic excellence to our schools;
- To return moral sanity and family values to our schools;

- To elect parents to community and statewide school boards who will hire parent-sensitive superintendents when current boards don't listen.

The primary targets of CEE are outcome-based education and liberal organizations such as the American Civil Liberties Union, People for the American Way, and the National Education Association (Ballen, 1995). CEE wants to shift the balance of influence in public schools to parents and local communities through grassroots programs and publicity and sees the teaching about religion in public schools as an essential component to a complete education (Zahorchak & Boyd, 1994).

The agenda of Focus on the Family is very much like those of the Christian Coalition and NACE/CEE, but it also stresses preservation of traditional values and the institution of the family (Focus on the Family, 1994). Focus on the Family supports the following educational outcomes (emphasis theirs):

- **Results** based on setting **clear academic goals and objectives**.
- **High standards of success for all students** as they learn the objectives and are then evaluated by objective tests (Ballen, 1995).

When trying to influence the content of public school curriculum, traditional curriculum supporters use a number of strategies ranging from litigation to personal persuasion (McCarthy, 1995). These groups have asserted that some materials promote either Christianity or an opposing creed and have even charged that certain books and instructional components (e.g., sex education, evolution) are antitheistic. These groups have been unsuccessful in litigation where they have alleged that specific materials unconstitutionally advance an antitheistic creed, and courts have found the challenged books and instructional components to be religiously neutral (*Grove v. Mead School District*, 1985; *Mozert v. Hawkins County*, 1988; McCarthy, 1995). While courts uphold school boards that defend instructional programs, they also uphold boards that are restricting the curriculum, as long as the boards follow their own adopted procedures and base their decisions on legitimate pedagogical concerns, even if the boards base their decisions on traditional religious beliefs (*Hazelwood v. Kuhlmeier*, 1988; *Virgil v. School Board*, 1989; *Zykan v. Warsaw*, 1980; McCarthy, 1995).

Since traditional groups know that there will be judicial deference to school boards, they have turned their central attention to influencing school board policies and elections (McCarthy, 1995). They successfully employ grass-roots strategies, such as door-to-door campaigns, to rally communities behind their attacks on particular aspects of public school programs (McCarthy, 1995). They effectively use democratic processes, "sometimes joining forces with taxpayers, senior citizens, and other conservative religious groups that share their agenda" (Arocha, 1993, p. 9). With such efforts, they have been very successful at strengthening their role in school board elections, claiming to have elected close to 10,000 school board members nationally since 1989 (McCarthy, 1995).

Traditional groups have been successful at recruiting parents as part of their grass-roots strategies. A good example is in the campaign against outcome-based education (OBE). Peg Luksik orchestrated a campaign against OBE that included hundreds of Pennsylvania town meetings and a widely distributed videotape entitled *Who Controls Our Children* (McCarthy, 1995). The campaign was very successful at convincing a large number of people that OBE was part of a federal conspiracy associated with invading their children's privacy, "stressing values over academic content, and holding students accountable for goals that are so vague and fuzzy they can't be assessed at all" (Olson, 1993, p. 25).

In addition, many seemingly unrelated statewide school restructuring efforts (e.g., Florida's Blueprint 2000, Indiana 2000) "have been attacked under the OBE umbrella because they include standards and assessments that emphasize problem solving and independent thinking" (McCarthy, 1995, p. 12). These groups successfully recruit parents and other voters because many of their allegations "tap into . . . legitimate fears shared by many American[s] . . . who don't trust either government or schools to do what's right for . . . [America's] children" (Barth, 1993, p. 43). Critics of the government and schools "feel that current reform efforts are wrongheaded, and [they] are fearful of radically different schools and the potential for technology to be used to invade students' privacy" (McCarthy, 1995, p. 12).

A key strategy for science and mathematics standards developers is to talk with parents and to gain their trust. The average person does not take the time to read policies, legislation, or curriculum frameworks, but instead relies on the interpretations of local concerned citizens, groups, and political officials for understanding documents. Historically, mathematics and science standards developers have not taken sufficient time to talk to parents to help them understand the true nature of standards (Dow, 1991). Public engagement, however, cannot resolve deeply held value conflicts about curriculum content priorities. When various groups rally for or against standards change, developers "may decide that the educational benefits of the programs or topics are not worth the risk of an emotional community controversy" (McCarthy, 1995, p. 13). Developers and educators may even avoid topics that they feel might arouse controversy from the particular parent groups and factions. This risky strategy may merely delay political reaction.

Summary of Conflicts in Determining Curriculum Standards

This paper has addressed numerous political issues concerning mathematics and science standards. As a summary, we present several dilemmas and trade-offs policymakers and educators will have to face when trying to develop nonincremental content standards (Kirst, 1994). The list is written from the vantage point of the decisions that will be faced by any group when it deliberates about mathematics and science content standards.

1. Who must be involved in the process to feel it is inclusive? Students? Business? If you exclude groups, you will be charged with bias. If you include every group that is suggested, you will have a cumbersome and slow process.

2. If you choose standards that achieve a broad consensus in the field, the "leading edge thinkers" will object. You will be accused of certifying "what is" rather than "what ought."
3. If you choose a standard that achieves consensus in a field, you will *not* be able to satisfy demands for "less is more"—consensus expands topics rather than reducing them.
4. If you choose a standard that reflects current content consensus, you will be criticized for not sufficiently stressing interdisciplinary content. There is limited interdisciplinary content in subject organizations like NCTM.
5. If you approve standards that are too general or do not contain pedagogy, you will be criticized for providing insufficient instructional guidance for teachers, and the content gaps will be filled by tests or assessments. If you do approve pedagogy or detailed standards, you will be criticized because standards are too long and complex and overly control local practice.
6. If you do not hear appeals from the public for specific content changes (e.g., inclusion of creation science), then you will be criticized for not having pubic participation *at the highest level* and for leaving crucial decisions to a technical panel of nonelected officials. If all these protests are considered, the process will become bogged down in time-consuming and fractious disputes.
7. If you approve similar structure or dimensions for all subjects, you will be criticized for ignoring the big (structural) differences between such fields as mathematics, science, and social studies.
8. If you hear appeals from subject-matter specialties (too much physics not enough biology), you will end up arbitrating balance among technical fields within a subject-matter area. If you do not hear these issues, you will be accused of approving unbalanced standards within a subject area; for example, there is too much physics and not enough biology in science content standards.

Local and State Policy Influentials in Standard Setting

Mathematics and science political conflicts must be decided by some authoritative political body (e.g., state or local government entities) if they are to become official policy. The critical state decision makers for mathematics and science standards will be different from those for policy in general and dependent on the political traditions within a particular state and local context. To understand the politics of policymaking, it is necessary to highlight the key actors. For example, many insiders and crucial players for science standards are "sometimes players" in general state policy analysis. Our rankings for science curriculum influentials at the state level is presented in Figure 1. The ordering is from the most to least influential in terms of being able to help determine state and local science policies.

Figure 1

Key Players in Standard Setting at the State Level

Insiders

- Professional associations in science, mathematics, and social studies: NSTA, AAAS, American Chemical Society, etc.

- Higher education policymakers and professors in science and related disciplines
- State curriculum framework policymakers
- Textbook publishers/testing agencies (private industry)
- NSF curriculum development
- National Education Goals Panel including the proposed National Assessment and Improvement Council
- National Research Council
- Leaders in education policy in the legislature

Near Circle
- State Board of Education (Text Adoption States)
- Teacher preparation institutions + teacher certification, National Council for the Accreditation of Teacher Education, National Board for Professional Teaching Standards, and American Association for Teacher Education.
- Ideological interest groups, e.g., creationists
- OERI in the U.S. Department of Education

Far Circle
- Organizations of state officials, National Governors' Association, Education Commission of the States
- Council of Chief State School Officers

Sometimes Players
- School accrediting agencies (e.g., North Central)
- Business organizations, minority organizations

[Categories adapted from Catherine Marshall et al., *Culture and Education Policy in the American States* (Falmer, 1989). Rankings based on review of literature concerning the politics of curriculum policymaking.]

This state map suggests that science standards reformers should focus on the insiders and the near circle and devote less attention to the far circle and sometimes players. Business groups, however, can be mobilized behind science/mathematics reform and are quite influential. There are also many crucial players at the local level that will help determine the success or failure of any standards proposal (see list below).

Local Level
- Local school boards
- Parent organizations
- Teacher unions
- LEA curriculum supervisors
- Administrators
- Department chairs

Some of the key local influentials are *not* organized in any way above the school or school district level, e.g., department chairs. They can be crucial in a specific locality, but are very difficult to target in a general reform strategy.

Final Thoughts

Mathematics and science content standards and exams are another chapter in the long-running saga of U.S. curriculum politics. Decisions on what knowledge is most worth knowing are at the center of school politics, even though school finance usually attracts more media attention. Curricular standards are the crucial component of the overall vision of systemic reform (Smith & O'Day, 1991). Content standards are a beginning for subsequent state and local policy alignment of textbooks, assessment, staff development, categorical programs, and accreditation. All of these policy areas must be linked to teaching the national content standards in America's classrooms for systemic reform to succeed. Consequently, standards for mathematics and science content are high-stakes politics.

Some potentially useful political strategies for mathematics and science curriculum developers include better public engagement and parent involvement; coalition building with business, higher education, vocational education, and teacher organizations; and a recognition that some value conflicts are so deep that no reasonable compromise is possible.

In its 1993 publication *Transforming Education: Overcoming Barriers* (David & Goren, 1993), the National Governors' Association offered six guidelines for governors pursuing systemic education reform. These guidelines offer insight for educators and policymakers at all levels who want to pursue the development of standards.

1. **Send clear and consistent signals.** Encourage review and removal of all policies inconsistent with systemic reform. Keep new policies to a minimum and consistent with a clearly stated policy for transforming education. Be sure there are clear two-way channels of communication throughout the system.
2. **Give priority to professional development.** Help redefine it as an ongoing part of the job of teaching, not just an occasional activity or workshop.
3. **Balance top-down and bottom-up strategies.** Strike a balance between setting the direction for change and supporting local problem-solving efforts. The goal of policy should be to enable reform, not to regulate and prescribe it.
4. **Create feedback mechanisms.** Policymakers need to hear from schools and school districts, especially those in high-poverty and minority areas. Avoid sole reliance on official representatives of interest groups.
5. **Make midcourse corrections.** Revisit policies as new information comes to light, and make adjustments when they're needed.
6. **Focus attention on education as a public good.** Emphasize the critical role of public schools in our democracy. Shift the debate away from laying blame for school shortcomings and toward a shared effort to make things better. This change will help keep small but vocal interest groups, individual horror stories, and political infighting from derailing the goals of reform.

Perhaps the key to science/mathematics curriculum content change is the linkage to broader political priorities. The alleged link between improved mathematics/science/technical education and future U.S. economic growth has fueled much of the political interest and finance to date.

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